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Ergonomic Evaluation Shangri-La Corp 3000 Lb. Double Stacker with Conveyor Bottom July 2000 By Rob Strickland, OTR

An ergonomic evaluation of the task of off-loading laminated wood load separators from a conveyor to a pallet was completed on July 19, 2000. A video tape and still photos were taken during the evaluation and are available for review. Copies of a discomfort survey were left for employees to fill out.

Purpose/Background:

The purpose of this evaluation is to provide an initial ergonomic assessment of the musculo-skeletal disorder (MSD) risk factors associated with this activity. Following implementation of engineering controls, a follow-up assessment will be made for comparison.

Observations:

This task involves picking up laminated wood load separators from a conveyor roller at waist level (34.25" high) as they exit the nailing machine and placing them in layers on a pallet. The separators are 3.5" wide by 2.25" thick and vary in weight according to length as follows:

| Length | Weight (pounds) |
|---------------|------------------------|
| 24" | 6.2 |
| 27" | 6.6 |
| 30" | 7.4 |
| 36" | 8.6 |
| 48" | 10.4 |
| 60" | 13.0 |
| 64" | 15.6 |
| 73" | 17.8 |

The worker grasps one or two separators at a time with gloved hands, turns and takes several steps to carry them and bends forward to place them in layers on the pallet. At the beginning of the pallet (bottom) the level is 6.5" off the ground. As the layers are built, the height reaches 50" of the floor at which time the load is banded with steel and removed by fork lift. At normal production levels each worker performing this task will handle 165 to 270 separators per hour or 2.75 to 4.5 per minute for 4 to 5 hours per day. This process typically involves turning or twisting at the trunk, taking several steps to the pallet, squatting or bending forward at the trunk to reach down and out to place the separator on the pallet. Body mechanics observed were generally quite poor.

The primary physical demands likely to contribute to risk of musculo-skeletal injury include:

1. Awkward postures- significant repetitive forward flexion (to 90 degrees or more) and rotation of the spine (lumbar & thoracic) with forward flexion of the shoulders (reaching down and forward). These postures may be utilized by some workers in excess of 25% of the work shift.

2. Forces and Loads- repetitive muscle loading of the trunk extensors while bending forward and of the quadriceps while squatting will likely result in muscle fatigue.
3. Repetition- moderately high rate of repetitive movements of upper extremities and trunk (cycle time is less than 30 seconds)
4. Pressure points- hard wood material and edges against soft tissues of hands (protected somewhat by gloves)
5. Muscle Recovery Time- very limited time for muscle recovery due to the continuous nature of the activity and lack of time spent in neutral or supported postures
6. Poor posture and Body Mechanics- workers are generally unable to maintain good body mechanics technique due largely to the design/layout of the task

These risk factors, when combined result in a moderately high risk of soft tissue (muscle, tendon, spinal disk) injury/disorder to the back and shoulders. This is born out by report of the employees. Of the eleven discomfort surveys filled out by workers, seven reported some degree of discomfort of the back or upper extremities related to the performance of this job.

These results indicate a strong need for engineering controls to eliminate or greatly reduce worker exposure to this task.

**Recommendations:
Engineering controls**

1. Design and build a tilting, pallet stacking device which can receive the separators directly from the end of the existing conveyor roller and thus eliminate manually stacking them. By controlling the height and slope of the device, the worker can guide and direct the separators by sliding them into position as the load is built layer by layer. This would allow the worker to maintain a nearly upright, balanced standing posture, while minimizing reaching activity as gravity would assist in the placement of the separators. The primary MSD risk factors would therefore be eliminated. The device should be efficient, simple to operate and not create additional MSD risk factors.

For further assistance or questions regarding this report please contact Rob Strickland, 503-667-3564.

Respectfully,

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Photos



Figure 1

Worker lifts and carries the load separators several feet from conveyor roller to the off-load stack, often bending down to place them on the bottom layers.



Figure 2

As layers are added, less bending is observed. This worker is twisting and reaching forward to place the separator on the stack.

Ergonomics and Musculoskeletal Disorders

BACKGROUND (Adapted from Federal Register, Nov. 23,1999, Department of Labor, OSHA, Ergonomics Program; Proposed Rule)

Ergonomics is the science of fitting the workplace conditions and job demands to the capabilities of the working population. It is an applied science, incorporating engineering, anatomy, physiology, psychology, anthropology and medical sciences. Effective “fits” assure high productivity, avoidance of illness and injury risks, with increased comfort and satisfaction among the work force. A primary goal of occupational ergonomics is the prevention of work-related musculoskeletal disorders (MSDs).

What are work-related musculoskeletal disorders?

MSDs are injuries or disorders of the muscles, tendons, joints, spinal discs, nerves, ligaments or cartilage. MSDs develop as a result of repeated exposure to ergonomic risk factors. Work related MSD's are those disorders to which the work environment and the performance of work contribute significantly. Another familiar and related term is cumulative trauma disorders, (CTDs). Common examples of MSDs include carpal tunnel syndrome, tendonitis, epicondylitis, herniated spinal discs, sciatica, low back pain, trigger finger and DeQuervain's disease.

What are ergonomic risk factors?

Ergonomic risk factors are the aspects of a job or task that impose biomechanical stress on the worker. Ergonomic risk factors are the synergistic elements of MSD hazards. OSHA discusses a large body of evidence supporting the finding that exposure to ergonomic risk factors in the workplace can cause or contribute to the risk of developing an MSD. This evidence, which includes thousands of epidemiologic studies, laboratory studies, and extensive reviews of the existing scientific evidence by NIOSH and the National Academy of Science, shows that the following ergonomic risk factors are most likely to cause or contribute to and MSD:

1. Force (i.e., forceful exertions, including dynamic motions)
2. Repetition
3. Awkward postures
4. Static postures
5. Contact Stress
6. Vibration
7. Cold temperatures

These risk factors are described briefly below:

Force

Force refers to the amount of physical effort that is required to accomplish a task or motion. Tasks or motions that require application of higher force place higher mechanical loads on muscles, tendons, ligaments and joints. Tasks involving high forces may cause muscles to fatigue more quickly. High forces also may lead to irritation, inflammation, strains and tears of muscles, tendons and other tissues. Force can be internal, such as when tension develops within the muscles, ligaments and tendons during movement. Force can also be external, as when a force is applied to the body, either voluntarily or involuntarily. Forceful exertion is often associated with the movement of heavy loads, such as lifting heavy packages, pushing a heavy cart, or moving a pallet. Hand tools that involve pinch grips require more forceful exertions than those that allow other grips such as a power grip.

Repetition

Repetition refers to performing a task or series of motions over and over again with little variation. When motions are repeated frequently (e.g., every few seconds) for prolonged periods (e.g., several hours, a work shift), fatigue and strain of the muscle and tendons can occur because there may be inadequate time for recovery. Repetition often involves the use of only a few muscles and body parts, which can become extremely fatigued while the rest of the body is little used. As task cycles in jobs get shorter (and the number of repetitions per minute increases) employees are at greater risk of injury. Where tasks cycles are short, the same muscles are in constant use and the muscles get no rest from the force required to perform the task cycle.

Awkward postures

Award postures refer to positions of the body (e.g., limbs, joints, back) that deviate significantly from the neutral position while job tasks are being performed. Neutral posture is the position of a body joint that requires the least amount of muscle activity to maintain. For example, the wrist is neutral in a handshake position, the shoulder is neutral when the elbow is near the waist, the back is neutral when standing upright.

Examples of awkward postures include: bent wrists while typing, bending over to grasp or lift an object, twisting back and torso while moving heavy objects and squatting. Awkward postures often are significant contributors to MSDs because they increase the work and the muscle force that is required.

Static postures

Static postures (or "static loading") refer to physical exertion in which the same posture or position is held throughout the exertion. These types of exertions put increase loads or forces on the muscles and tendons, which contributes to fatigue. This occurs because not moving impedes the flow of blood that is needed to bring nutrients to the muscles and to carry away the wasted products of muscle metabolism. Examples of static postures include gripping tools that cannot be put down, holding the arms out or up to perform tasks, or standing in one place for prolonged periods.

Vibration

Vibration is the oscillatory motion of a physical body. Localized vibration, such as vibration of the hand and arm, occurs when a specific part of the body comes into contact with vibration objects such as powered hand tools (e.g., chain saw, electric drill, chipping hammer) or equipment (e.g., wood planer, punch press, packaging machine). Whole-body vibration occurs when standing or sitting in vibrating environments (e.g., driving a truck over bumpy roads) or when using heavy vibrating equipment that requires whole-body involvement (e.g., jackhammers).

Contact stress

Contact stress results from occasional, repeated or continuous contact between sensitive body tissue and a hard or sharp object. Contact stress commonly affects the soft tissue on the fingers, palms, forearms, thighs, shins and feet. This contact may create pressure over a single area of the body (e.g., wrist, forearm) that can inhibit blood flow, tendon and muscle movement and nerve function. Examples of contact stress include resting wrists on the sharp edge of a desk or workstation while performing tasks, pressing of tool handles into the palms, especially when they cannot be put down, tasks that require hand hammering, and sitting down without adequate space for the knees.

Cold temperatures

Cold temperatures refer to exposure to excessive cold while performing work tasks. Cold temperatures can reduce the dexterity and sensitivity of the hand. Cold temperatures, for example, cause the worker to apply more grip force to hold hand tools and objects. Also, prolonged contact with cold surfaces (e.g., handling cold meat) can impair dexterity and induce numbness. Cold is a problem when it is present with other risk factors and is especially problematic when it is present with vibration exposure.

Exposure to one ergonomic risk factor may be enough to cause or contribute to an MSD. For example, a job task may require exertion of so much physical force that, even though the task does not involve additional risk factors such as awkward postures or repetition, an MSD is likely to occur. However, most often ergonomic risk factors act in combination to create a hazard. Evidence shows that of these risk factors, the combination of force, repetition and awkward postures, especially when occurring at high levels are most often associated with the occurrence of MSDs. Jobs that have multiple risk factors have a greater likelihood of causing or contributing to MSDs, depending on the duration, frequency and magnitude of employee exposure to each risk factor or to a combination of them. Thus, it is important that ergonomic risk factors be considered in light of their combined effect in causing or contributing to an MSD.

Solving Ergonomic Problems

As stated above, a primary goal of ergonomics is the prevention of work-related musculoskeletal disorders (MSDs). Ideally, this is accomplished while simultaneously enhancing the productivity and job satisfaction of the employee work group. This is accomplished by identifying the ergonomic risk factors and systematically eliminating or reducing employee exposure to them. There are three approaches to this process described briefly below:

Engineering controls:

Engineering controls are physical changes to a job that eliminate or materially reduce the presence of MSD hazards. They are the primary and preferred method of improving job tasks to reduce exposure to MSD risk factors. Examples of engineering controls for MSD hazards include changing, modifying or redesigning the following:

1. Workstations
2. Tools
3. Facilities
4. Equipment
5. Materials
6. Processes

Work practice controls:

Work practice controls involve changes in the way an employee does the job. They are defined as changes in the way an employee performs the physical work activities of a job that reduce exposure to MSD hazards. Work practice controls involve procedures and methods for performing work safely. Examples of this type of control are training workers to: use good body mechanics and lifting techniques, to vary the tasks they perform throughout the day to minimize muscle fatigue and to use a new or modified tool properly. In the context of ergonomic programs, work practice controls are essential, both because they reduce ergonomic stressors in their own right and because they are critical if engineering controls are to work effectively.

Administrative controls:

Administrative controls are management-controlled work practices and policies designed to reduce exposures to MSD hazard by changing the way work is assigned or scheduled. Administrative controls reduce the frequency, magnitude, and/or duration of exposure and thus reduce the cumulative dose to any one worker. Examples of this type of control are employee rotation, job enlargement, and employer-authorized changes in the pace of work. Administrative controls should be used with caution and only after careful consideration of all reasonable engineering controls.

Ergonomic assessment tools:

- NIOSH Guide to Manual Lifting
- Postural assessments
- Risk factor check lists
- Task frequency and duration
- Force/weight measurements
- Dimension measurements
- Anthropometry data comparisons
- Energy demand
- Body mechanics assessment
- Environmental factors

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